

Putting on the Brakes

Hickam civil engineers undertake the first installation of a new textile brake aircraft arresting system for the Air Force

by Creighton Lee
15th CES

Members of the 15th Civil Engineer Squadron recently installed textile brakes, the newest addition to the Air Force's aircraft arresting system (AAS) inventory, on the runway at Honolulu International Airport, HI. Textile brakes were recently selected for use on Air Force bases due to their flexibility and low maintenance costs, and due to the pending removal of the BAK-9, an obsolete rotary friction brake system, from the Air Force inventory.

The BAK-9

The BAK (barrier, arresting kit) system was developed in the 1950s by the E.W. Bliss Company to safely stop any hook-equipped aircraft during an aborted takeoff or in-flight emergency. With an

energy capacity of approximately 55 million foot-pounds, it was a big improvement over the conventional MA-1A or E-5 arresting gear previously used. Those systems employed ships' anchor chains and had only a 12 million foot-pound capacity to slow runaway planes.

Prior to June 2001, Hickam Air Force Base had a BAK-9 in place at Honolulu International Airport in the overrun area of the primary departure runway to accommodate emergency engagements for alert aircraft. The airport also has two BAK-12/14s on another runway, but the alert mission dictates the need to maintain emergency capability in the overrun.

The BAK-9 was installed in 1964, and for 36 years the system was never involved in an actual engagement, aborted takeoff or in-flight emergency. Meanwhile, the technical order that governs BAK-9 maintenance requires an annual certification engagement if no actual arrestment has been accomplished.

The certification process requires that a hook-equipped aircraft perform a roll-in engagement toward the midpoint of the runway at approximately 95 knots to test the integrity and reliability of the arresting system. However, due to the system's location in the overrun area, this was not possible. Instead, a third party was required to perform a visual inspection of the BAK-9 and review all maintenance records each

year. Successful completion of this inspection allowed the 15th CES to keep the BAK-9 in service.

BAK-9 versus BAK-12

In 1996, the 15th CES was informed that by 2003 the BAK-9 would no longer be logistically supportable. With the phase-out of BAK-9, replacement options were limited to BAK-12 or textile brake.

The BAK-12 is the standard Air Force operational aircraft arresting system, but because of sighting constraints, intersecting taxiways and limited space on the overrun area, using the BAK-12 was not a viable alternative.

In addition, a BAK-12 system costs about \$500,000 to buy and install, and about \$60,000 per year to maintain. By comparison, a textile brake can be purchased and installed for about \$100,000, and costs \$60,000 to re-rig after an emergency engagement.

Replacing the BAK-9

In 1997, while attending a conference on barriers, a representative from the Headquarters Pacific Air Forces Civil Engineer Operations Division inquired about a textile brake system developed by a French company called Aerazur as a possible replacement for the BAK-9.

Personnel in the Air Force Civil Engineer Support Agency's Technical Support Directorate worked with the Air Armament Center at Eglin AFB to develop a plan and test the textile brake system for Air Force use.

"We used instruments that measured the loads on an aircraft's tail hook and high-speed photography to observe how the textile brake system tears apart to stop a plane," said Mike Ates, AFCESA's airfield criteria program manager. Seventeen tests were performed during two visits to the Navy's Lakehurst testing facility in New Jersey during May 1998 and November 1999.

Results from the tests met the aircraft weight/speed capabilities for overrun emergency engagements. Successful engagements of up to 145.6 knots were demonstrated, evaluated and validated for recommendation and acceptance by Air Armament Center Air



The 15th CES poured about 62 cubic yards of concrete for the textile brake foundation. The installed concrete pad allows for up to 12 module bags on each side of the runway. (Photos courtesy 15th CES)

Base Operations at Eglin, then forwarded for final approval to the San Antonio Air Logistics Center, whose functions have since relocated to Robins AFB, GA.

Why Textile?

The textile brake was chosen for installation at Hickam AFB/Honolulu International Airport due to its simplicity and minimal maintenance requirements and the site constraints.

The textile brake uses a tearing strap to absorb an aircraft's kinetic energy during an arrestment. Two tightly woven nylon straps are sewn together, and it is the longitudinal tearing or shearing of the two straps that provides the braking capability to safely stop the aircraft. It takes 15,000 pounds of force to tear one pair of straps.

The textile brake model (MB 100.10c) used at Hickam is comprised of a set of 10 modules (consisting of the tearing straps) housed in protective environmental covers positioned on each side of the runway. They are connected to a standard 1.25-inch hook cable that is supported every 5 feet by 6-inch rubber donuts. The hook cable is attached to a manually operated winch that allows operators to tension the cable.

The straps are sent to the Aerazur plant in Paris every two years to determine their reliability. With five testing straps on each side, the textile brakes have a 10-year installed life. Replacement stored modules are tested every five years.

While the textile brake is designed as a one-time use device, the lifecycle cost is still less than half that of a BAK-9 or a BAK-12. Although the BAK-12 can sustain 500 arrestments without an overhaul, it has to be overhauled anyway after 10 years at a cost of \$120,000. It costs half that to replace the nylon strap modules on the textile brake system when it begins to age.

Another advantage of the textile brake system is its portability during deployments. "Conventional gear would have to be airlifted on a C-130 transport plane for about \$500,000," said Ates, "But the nylon can be installed in a mobile fashion at half the time and cost, and it would take just one pallet position on a C-130."

A disadvantage of the fabric brake is that once it has been engaged, a ground crew has to clean up the shredded nylon from the runway area, and the modules must be

replaced. However, according to Ates, the entire Air Force only has about seven emergency arrestments on overruns per year.

Installation

Several 15th CES craftsmen were involved in the successful installation of the new textile brake system.

Phase 1, which ran for 10 nights in August 2001, resulted in removal of the BAK-9 and all associated equipment and destruction of the underground barrier pit floor.

The compaction phase took place after the demolition of the BAK-9 floor, however, due to the events of Sept. 11, work was postponed until October.

Compaction was accomplished by completing 4-inch lifts over a period of 16 days for 100 percent density, followed by surveying and preparation for the installation of the forms for the concrete foundations. The team poured 26 cubic yards of concrete for each foundation. A second pair of triangle-shaped forms was poured using about 5 cubic yards of concrete each, totaling 62 cubic yards of concrete for the foundation.

More compaction of back fill and the final paving of the asphalt followed. The required slope of the foundation to the runway was met, and the foundations completed, in November.

Installation of the textile brake system components was completed in one day. The installation used 100-meter bags, 10 on each side of the runway. The new concrete pad allows for increasing the number of modules to 12 on each side.

Certification and acceptance was conducted and approved by Aerazur and the Air Armament Center, and, following full curing time for the concrete and a pull-test by CE on the installed J-hooks, the barrier was operational in early December. A NOTAM declaring the textile brake system fully operational was issued Dec. 8, 2001.

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Editor's Note: Civil engineers have since installed a textile brake system at MacDill AFB, FL, and will install two more systems at Andrews AFB, MD, in the near future.



The textile brake uses a tearing strap to absorb the aircraft's kinetic energy during an arrestment. Since the textile brake is designed as a one-time use system, it was installed in a location shown to have a low probability of an actual arrestment.